

INCH-POUND

MIL-PRF-83530B

24 September, 1999

SUPERSEDING

MIL-PRF-83530A

6 July 1993

MILITARY SPECIFICATION

RESISTORS, VOLTAGE SENSITIVE (VARISTOR, METAL-OXIDE), GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for voltage sensitive resistors (varistors) to be used for suppressing transients in electronic circuitry.

1.2 Classification.

1.2.1 Part or Identifying Number (PIN). The resistors specified herein (see 3.1) are identified by a PIN which consists of the basic number of the specification and a coded number. The PIN appears in the following form:

<u>M83530/1-</u>	<u>2200</u>	<u>D</u>
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Specification number	Nominal Voltage (see 1.2.1.1)	Voltage tolerance (see 1.2.1.2)

1.2.1.1 Nominal voltage. The nominal voltage value expressed in volts is identified by a four digit number; the first three digits represent significant figures and the last digit specifies the number of zeros to follow.

Examples: 1000 = 100 volts
1001 = 1,000 volts
1002 = 10,000 volts

Minimum and maximum voltage values are as specified (see 3.1). The standard values for every decade follow the sequence demonstrated for the "10 to 100" decade.

1.2.1.2 Voltage tolerance. The voltage tolerance is identified by a single letter in accordance with table I.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAT, P.O. 3990, Columbus, Ohio, 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

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FSC 5905

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TABLE I. Voltage Tolerance.

Letter	Voltage tolerance
	<u>Percent</u>
A	±15
B	±10
C	±5
D	+10, -5
E	+5, -10
F	+10, -0

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-83530/1 - Resistors, Voltage Sensitive (Varistor), Style RVS10

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-202 - Test Methods Standard Electronics and Electrical Component Parts.

MIL-STD-750 - Test Methods for Semiconductor Devices.

MIL-STD-810 - Environmental Test Methods.

MIL-STD-1285 - Marking of Electrical and Electronic Parts.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Defense Automated Printing Service, Building 4D, (DPM-DoDSSP), 700 Robins Avenue, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/NCSL Z540-1 - Calibration Laboratory and Measuring and Test Equipment - General Requirements

INTERNATIONAL ORGANIZATION FOR STANDARDS (ISO)

ISO 10012-1 - Quality Assurance Requirements for Measuring Equipment, Part 1:
Meteorological Confirmation System for Measuring Equipment.

(Applications for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, New York, NY 10036-8002.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.4 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for related associated specifications, specification sheets or MS standards), the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between requirements of this specification and the specification sheet, the latter shall govern (see 6.2).

3.2 Qualification. Resistors furnished under this specification shall be products which are qualified for listing on the applicable qualified products list prior to the award of a contract (see 4.4 and 6.3).

3.3 Materials. Materials shall be used which will enable the resistors to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.4 Interface and physical dimension requirements. Resistors shall meet the interface and physical dimension requirements as specified (see 3.1).

3.4.1 Terminal leads. Terminal leads shall be made of a solid conductor of the length and diameter specified. (See 3.1). They shall be suitably treated to meet the requirements of solderability. (see 3.14). When a tin lead solder coating is used, the tin content shall be between 40 and 70 percent.

3.4.1.1 Solder dip (retinning) of leads. Procedure for the solder dip (retinning) of leads is outlined in the Appendix, paragraph 40.

3.4.2 Solder Flux. When soldering fluxes are required during manufacturing processes, noncorrosive fluxes shall be used.

3.5 Voltage rating. Resistors shall have a rated direct-current (dc) continuous operating voltage, or a rated sine-wave root-mean-square (rms) alternating-current (ac) continuous operating voltage at commercial-line frequency and waveform as specified (See 3.1). This voltage is dependent on the ability of resistors to meet the operating life requirements specified in 3.28.

3.6 Power rating. Resistors shall have transient average power dissipation ratings (see 3.1) based on a group of pulses occurring within a specified isolated time period. This rating is based on the ability of resistors to meet the pulse life requirements specified in 3.11.

$$E = \sqrt{PR}$$

Where:

E = Continuous rated dc or rms working voltage in volts.

P = Rated power in watts.

R = Nominal resistance in ohms.

3.7 Nominal voltage. When resistors are tested as specified in 4.6.2, the dc voltage shall not exceed the specified tolerance of the nominal voltage (see 3.1).

3.8 Clamping voltage. When tested as specified in 4.6.3, the clamping voltage shall not exceed the specified maximum value (see 3.1).

3.9 Capacitance. When tested as specified in 4.6.4, the capacitance shall not exceed the specified maximum value (see 3.1).

3.10 Peak current rating. When tested as specified in 4.6.5, the resistors shall have a peak single pulse transient current rating as specified (see 3.1) without exceeding the specified peak current clamping voltage (see 3.1). Upon completion, the resistors shall meet the following requirements:

Clamping voltage (3.8) - Change shall not exceed +20%.
Nominal voltage (3.7) - Change shall not exceed -10%.
Visual examination - There shall be no evidence of mechanical damage.

3.11 Pulse life rating. When tested as specified in 4.6.6, the resistors shall have a pulse life rating as specified (see 3.1). Upon completion of the test, the resistors shall meet the following requirements:

Clamping voltage (3.8) - Change shall not exceed +20%.
Nominal voltage (3.7) - Change shall not exceed -10%.
Visual examination - There shall be no evidence of mechanical damage.

3.12 Energy rating. When tested as specified in 4.6.7, the resistors shall have an energy rating as specified (see 3.1). Upon completion of the test, the resistors shall meet the following requirements:

Clamping voltage (3.8) - Change shall not exceed +20%.
Nominal voltage (3.7) - Change shall not exceed -10%.
Visual examination - There shall be no evidence of mechanical damage.

3.13 Dielectric withstanding voltage. When tested as specified in 4.6.8, the resistors shall meet the following requirements:

Leakage current - Shall not exceed 1 milliamperes at any time during test.
Visual examination - There shall be no evidence of mechanical damage, arcing, or breakdown.

3.14 Solderability. When tested as specified in 4.6.9, the resistors shall meet the criteria for wire-lead terminal evaluation in the test method.

3.15 Resistance to soldering heat. When tested as specified in 4.6.10, the resistors shall meet the following requirements:

Clamping voltage (3.8) - Change shall not exceed +20%.
Nominal voltage (3.7) - Change shall not exceed -10%.
Visual examination - There shall be no evidence of mechanical damage.

3.16 Resistance to solvents. When tested as specified in 4.6.11, there shall be no evidence of mechanical damage to the body and the marking shall remain clear and legible.

3.17 Flammability (external flame). When tested as specified in 4.6.12, the time for flaming combustion of resistors to self-extinguish shall not exceed 7 seconds on any test. The average of all tests, the time to self-extinguish shall not exceed 5 seconds. The time of persistence of glowing combustion of resistors shall not exceed 30 seconds after removal of test flame. Resistors shall not drip flaming particles that ignite dry absorbent surgical cotton.

3.18 Terminal strength. When tested as specified in 4.6.13, there shall be no evidence of breaking or loosening of terminals from the resistor form, chipping of coating, or any other evidence of mechanical damage.

3.19 High temperature life (stabilization bake). When tested as specified in 4.6.14, the resistors shall show no evidence of mechanical damage.

3.20 Thermal shock. When tested as specified in 4.6.15, the resistors shall show no evidence of mechanical damage.

3.21 Power burn-in. When tested as specified in 4.6.16, the resistors shall show no evidence of mechanical damage.

3.22 Moisture resistance. When tested as specified in 4.6.17, the resistors shall meet the following requirements:

Dielectric withstanding voltage - As specified in 3.13.
Nominal voltage - Change shall not exceed -10%.

3.23 Vibration. When tested as specified in 4.6.18, the resistors shall meet the following requirements:

Clamping voltage (3.8) - Change shall not exceed +20%.
Nominal voltage (3.7) - Change shall not exceed -10%.
Visual examination - There shall be no evidence of mechanical damage.

3.24 Shock. When tested as specified in 4.6.19, the resistors shall meet the following requirements:

Clamping voltage (3.8) - Change shall not exceed +20%.
Nominal voltage (3.7) - Change shall not exceed -10%.
Visual examination - There shall be no evidence of mechanical damage.

3.25 Constant acceleration. When tested as specified in 4.6.20, the resistors shall meet the following requirements:

Clamping voltage (3.8) - Change shall not exceed +20%.
Nominal voltage (3.7) - Change shall not exceed -10%.
Visual examination - There shall be no evidence of mechanical damage.

3.26 Low temperature storage. When tested as specified in 4.6.21, the resistors shall meet the following requirements:

Clamping voltage (3.8) - Change shall not exceed +20%.
Nominal voltage (3.7) - Change shall not exceed -10%.
Visual examination - There shall be no evidence of mechanical damage.

3.27 High temperature storage. When tested as specified in 4.6.22, the resistors shall meet the following requirements:

Clamping voltage (3.8) - Change shall not exceed +20%.
Nominal voltage (3.7) - Change shall not exceed -10%.
Visual examination - There shall be no evidence of mechanical damage.

3.28 Operating life. When tested as specified in 4.6.23, the resistors shall meet the following requirements:

Clamping voltage (3.8) - Change shall not exceed +20%.
Nominal voltage (3.7) - Change shall not exceed -10%.
Visual examination - There shall be no evidence of mechanical damage.

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3.29 Marking. The resistors shall be marked with the PIN, manufacturer's CAGE, date code and lot code. The part number may appear on two lines and in such case shall be divided between the / and the specification sheet number. The date code shall be the date of the final assembly operation for the production lot as defined in

4.5.1.1.2. The following is an example of the marking:

M83530/ PIN
1-2200D
12345 - Manufacturer's CAGE
8636XX- Date code and lot code

3.30 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.31 Workmanship. Resistors shall be processed in such a manner as to be uniform in quality and free from defects that may adversely affect operability, reliability or appearance. The wire leads or terminals shall be unbroken, and not crushed or nicked.

4. VERIFICATION

4.1 Classification of inspection. The examination and testing of resistors shall be classified as follows:

- a. Qualification inspection (see 4.4).
- b. Quality conformance inspection (see 4.5).

4.2 Test equipment and inspection facilities. The supplies shall establish and maintain a calibration system in accordance with NASI/NCSL Z540-1, ISO 10012-1, or equivalent system as approved by the qualifying activity.

4.3 Inspection conditions and precautions.

4.3.1 Conditions. Unless otherwise specified herein, all inspections shall be made in accordance with the "GENERAL REQUIREMENTS" of MIL-STD-202.

4.3.2 Precautions. Adequate precautions shall be taken during inspection to prevent condensation of moisture on resistors, except during moisture-resistance test.

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production.

4.4.1 Sample. The number of sample units comprising a sample of resistors to be submitted for qualification inspection shall be 52. The sample shall be taken at random from a production run, and shall be produced with equipment and procedures normally used in production. Each voltage rating of each resistor style shall be qualified separately.

4.4.2 Test routine. Sample units shall be subjected to the qualification inspection specified in table II, in the order shown. All sample units shall be subjected to the inspection of group I. The 52 sample units from group I shall then be divided as specified in table II for groups II to V inclusive, and subjected to the inspections for their particular group.

4.4.3 Failures. Failures in excess of those allowed in table II shall be cause for refusal to grant qualification.

TABLE II. Qualification inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units	Allowable failures group/cumulative	
<u>Group I</u> Visual and mechanical Inspection <u>1/</u> High temperature (stabilization bake) Thermal shock Power burn-in Clamping voltage <u>1/</u> Nominal voltage <u>1/</u>	3.1, 3.3 to 3.4.2 incl. and 3.29, 3.30 3.19 3.20 3.21 3.8 3.7	4.6.1 4.6.14 4.6.15 4.6.16 4.6.3 4.6.2	All Units	0	
<u>Group II</u> Solderability Resistance to soldering heat Resistance to solvents ... Flammability (external flame)	3.14 3.15 3.16 3.17	4.6.9 4.6.10 4.6.11 4.6.12	12	0	
<u>Group III</u> Low temperature storage High temperature storage Capacitance <u>1/</u> Dielectric withstanding voltage <u>1/</u>	3.26 3.27 3.9 3.13	4.6.21 4.6.22 4.6.4 4.6.8	10	1	1
<u>Group IV</u> Terminal strength (lead fatigue) Moisture resistance Pulse life	3.18 3.22 3.11	4.6.13 4.6.17 4.6.6	10	1	1
<u>Group V</u> Vibration Shock Constant acceleration ... Energy	3.23 3.24 3.25 3.12	4.6.18 4.6.19 4.6.20 4.6.7	10	1	2
<u>Group VI</u> Peak current Operating life	3.10 3.28	4.6.5 4.6.23	10	1	2

1/ Nondestructive

4.4.4 Retention of qualification. Every 12-months, the manufacturer shall verify the retention of qualification to the qualifying activity. In addition, the manufacturer shall immediately notify the qualifying activity whenever the group B results indicate failure of the qualified product to meet the requirements of the specification. Verification shall be based on meeting the following requirements:

- a. The manufacturer has not modified the design of the item.
- b. The specification requirements for the item have not been amended so far as to affect the character of the item.
- c. Lot rejection for group A inspection does not exceed the group A sampling plan.
- d. The requirements for group B inspection are met.

When group B requirements were not met and the manufacturer has taken corrective action satisfactory to the government, group B inspection retesting shall be instituted.

4.5 Quality conformance inspection.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspections.

4.5.1.1 Inspection and production lot.

4.5.1.1.1 Inspection lot. An inspection lot shall consist of all resistors of the same part number, under essentially the same conditions and offered for inspection during a period of 1 month.

4.5.1.1.2 Production lot. A production lot consists of parts manufactured from the same basic raw materials, processed under the same specifications and procedures, and produced with the same equipment. Each production lot of parts should be a group identified by a common manufacturing record through all significant manufacturing operations, including the final assembly operation. The final assembly operation shall be considered the last major assembly operation, such as casing, hermetic sealing, or lead attachment, rather than painting or marking, for example.

4.5.1.2 Group A inspection. Group A inspection shall consist of the inspections specified in table III and shall be made on the same set of sample units, in the order shown.

4.5.1.2.1 Sampling plan.

4.5.1.2.1.1 Subgroup 1. Subgroup 1 tests shall be performed on 100 percent of the product supplied under this specification. Resistors which fail to meet the requirements of the tests of this subgroup shall be removed from the lot. Lots having more than 10 percent total rejects shall not be furnished on contracts.

4.5.1.2.1.2 Subgroup 2. A sample of parts from each inspection lot shall be randomly selected in accordance with table IV. If one or more defects are found, the lot shall be reworked or screened and defectives removed. After reworking or screening and removal of defectives, a new sample of parts shall be randomly selected in accordance with table IV. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

4.5.1.2.1.3 Subgroup 3 (solderability).

4.5.1.2.1.3.1 Sampling plan. A sample of parts from each inspection lot shall be randomly selected in accordance with table IV and subjected to the subgroup 3 solderability test. If there are one or more defects, the lot shall be considered to have failed.

TABLE III. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph	Sampling plan
<u>Subgroup 1</u>			
High temperature life (stabilization bake)	3.19	4.6.14	See 4.5.1.2.1.1
Thermal shock	3.20	4.6.15	
Power burn-in	3.21	4.6.16	
Clamping voltage	3.8	4.6.3	
Nominal voltage	3.7	4.6.2	
<u>Subgroup 2</u>			
Visual and mechanical examination	---	4.6.1	See 4.5.1.2.1.2
Body dimensions	3.4	---	
Diameter and length of leads	3.4.1	---	
Marking (where applicable) <u>1/</u>	3.29	---	
Workmanship	3.30	---	
<u>Subgroup 3</u> <u>2/</u>			
Solderability	3.14	4.6.9	See 4.5.1.2.1.3

1/ Marking defects shall be charged only for illegible, incorrect, or incomplete marking. Any subsequent electrical defects shall not be charged as marking defect.

2/ The manufacturer may request the deletion of the Subgroup 4 solderability test, provided an in-line or process control system for assessing and assuring the solderability of terminations can be validated and approved by the qualifying activity. Deletion of the test does not relieve the manufacturer from meeting this test requirement in case of dispute. If the design, material, construction, or processing of the part is changed or if there are any quality problems, the qualifying activity may require resumption of the test.

4.5.1.2.1.3.2 Rejected lots. In the event of one or more defects, the inspection lot is rejected. The manufacturer may use one of the following options to rework the lot:

- a. Each production lot that was used to form the failed inspection lot shall be individually submitted to the solderability test as required in 4.6.9. Five samples shall be selected from each production lot that formed the failed inspection lot. Production lot samples that pass the solderability test are available for shipment. Production lots failing the solderability test can be reworked only if submitted to the solder dip procedure in (b).
- b. The manufacturer submits the failed lot to a 100 percent solder dip using an approved solder dip process per the appendix, paragraph 40. Following the solder dip, the electrical measurements required in group A, subgroup 1, tests shall be repeated on 100 percent of the lot. The PDA for the electrical measurements shall be as for the subgroup 1 tests. Thirteen additional samples shall then be selected and subjected to the solderability test with zero defects allowed. If the lot fails this solderability test the lot may be reworked a second time and retested. If the lot fails the second rework, the lot shall be considered rejected and shall not be furnished against the requirements of this specification.

4.5.1.2.1.3.3 Disposition of samples. The solderability test is considered a destructive test and samples submitted to the solderability test shall not be supplied on the contract.

TABLE IV. Group A inspection sampling plan.

Lot size	Subgroup 2 sampling plan	Subgroup 3 sampling plan
1 to 8	100 percent	100 percent
9 to 150	13	5
151 to 280	20	5
281 to 500	29	5
501 to 1,200	34	5
1,201 to 3,200	42	5
3,201 to 10,000	50	8
10,001 to 35,000	60	13
35,001 to 150,000	74	20
150,001 to 500,000	90	20
500,001 and over	102	20

4.5.1.3 Group B inspection. Group B inspection shall consist of the tests specified in table V in the order shown. They shall be performed on sample units that have been subjected to and have passed group A inspection.

4.5.1.3.1 Sampling plan.

4.5.1.3.1.1 Subgroup 1. A sample of parts shall be randomly selected in accordance with table VI. If one or more defects are found, the lot shall be reworked or screened and defectives removed. After reworking or screening and removal of defectives, a new sample of parts shall be randomly selected in accordance with table VI. If one or more defects are found in the second sample, the lot shall be not supplied to this specification.

TABLE V. Group B inspection.

Inspection	Requirement paragraph	Test Method paragraph	Sampling plan
<u>Subgroup 1</u> Dielectric withstanding voltage	3.13	4.6.8	See 4.5.1.3.1.1
<u>Subgroup 2</u> ^{1/} Resistance to solvents	3.16	4.6.11	See 4.5.1.3.1.2
<u>Subgroup 3</u> ^{1/} Terminal strength (lead fatigue) Moisture resistance Peak current Energy rating	3.18 3.22 3.10 3.12	4.6.13 4.6.17 4.6.5 4.6.7	See 4.5.1.3.1.3

- ^{1/} If the manufacturer can demonstrate that this test has been performed five consecutive times with zero failures, this test, with the approval of the qualifying activity, can be deleted. The manufacturer, however, shall perform this test every three years after the deletion as part of long term design verification. If the design, material, construction, or processing of the part is changed or, if there are any quality problems, the qualifying activity may require resumption of the specified testing. Deletion of testing does not relieve the manufacturer from meeting the test requirement in case of dispute.

4.5.1.3.1.2 Subgroup 2. A sample of 12 parts shall be randomly selected. If one or more defects are found, the lot shall be reworked or screened and defectives removed. After reworking or screening and removal of defectives, a new sample of 12 parts shall be randomly selected. If one or more defects are found in the second sample, the lot shall be not supplied to this specification.

4.5.1.3.1.3 Subgroup 3. A sample of parts shall be randomly selected in accordance with table VI. If one or more defects are found, the lot shall be reworked or screened and defectives removed. After reworking or screening and removal of defectives, a new sample of parts shall be randomly selected in accordance with table VI. If one or more defects are found in the second sample, the lot shall be not supplied to this specification.

4.5.1.3.2 Disposition of sample units. Sample units which have been subjected to Group B subgroups II or III shall not be delivered on the contract or order.

TABLE VI. Group B sampling plan.

Lot size	Group B sampling plan
1 to 50	5
51 to 90	7
91 to 150	11
151 to 280	13
281 to 500	16
501 to 1,200	19
1,201 to 3,200	23
3,201 to 10,000	29
10,001 to 35,000	35
35,001 and over	40

4.5.1.4 Periodic inspection. Periodic inspection shall consist of group C inspection. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.5.1.4.4), delivery of products which have passed groups A and B inspections shall not be delayed pending the results of these periodic inspections.

4.5.1.4.1 Group C inspection. Group C inspection shall consist of the tests specified in table VII. They shall be performed on sample units of each style and characteristic selected from lots which have passed groups A and B inspections.

4.5.1.4.2 Sampling plan. Sample size and frequency of sampling shall be as specified in Table VII.

4.5.1.4.3 Disposition of sample units. Sample units which have been subjected to group C inspection shall not be delivered on the contract.

4.5.1.4.4 Noncompliance. If a sample fails to pass group C inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure and shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all inspections or the inspection which the original sample failed, at the option of the qualifying activity). Groups A and B inspection may be reinstituted; however, final acceptance and shipment shall be withheld until the group C reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and the corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity.

TABLE VII. - Group C inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units	Failures allowed
<u>Every 6 months</u>				
High temperature storage ..	3.27	4.6.22	10	0
Operating life (steady state)	3.28	4.6.23	10	0
Pulse life rating	3.11	4.6.6	10	0
Shock	3.24	4.6.19	10	0
Vibration	3.23	4.6.18	10	0
Constant acceleration	3.25	4.6.20	10	0
Energy rating	3.12	4.6.7	10	0

4.6 Methods of examination and test.

4.6.1 Visual and mechanical examination. Resistors shall be examined to verify the materials, design, construction, physical dimensions, marking and workmanship are in accordance with the applicable requirements (see 3.1, 3.3, 3.4, 3.4.1, 3.4.2, 3.29, and 3.30). Defects are classified as shown in table VIII.

TABLE VIII. Defects.

Defects
Cracks, voids, chips or holes in the resistor body which would expose the resistor element or could cause probable failure.
Leads or terminals which are broken, crushed or nicked which would cause probable failure in use.
Body or lead dimensions out of specification.
Incorrect, illegible marking.

4.6.2 Nominal voltage (see 3.7). Resistors shall be tested in accordance with method 4022 of MIL-STD-750. The following details and exceptions shall apply:

- Test current - 1.0 ± 0.1 mA dc.
- Time of test current application prior to voltage reading - 5 milliseconds minimum, 5 seconds maximum.
- Method of mounting - not specified.
- Resistors shall be tested in both polarities.

4.6.3 Clamping voltage (see 3.8). Resistors shall be tested in accordance with method 4011 of MIL-STD-750. The following details and exceptions shall apply:

- Test current - An impulse with waveform of $8 \times 20 \mu\text{S}$ (See 6.5.2) and peak value, $\pm 5\%$ as specified (see 3.1).
- Pulse repetition rate - Shall not exceed one per second.
- Resistors shall be tested in both polarities.

4.6.4 Capacitance (see 3.9). Resistors shall be tested in accordance with method 4001 of MIL-STD-750. The following details and exceptions shall apply:

- a. DC bias voltage - Shall not be applied.
- b. Test voltage - 1.0 ± 0.1 V rms.
- c. Test frequency - 1.0 MHz $\pm 5\%$.

4.6.5 Peak current (see 3.10). Resistors shall be tested in accordance with method 4141 of MIL-STD-750. The following details and exceptions shall apply:

- a. Pulse generator source impedance and pulse voltage - Shall be such as to supply the specified peak current value $\pm 10\%$ (see 3.1).
- b. Pulse width - An impulse waveform of $8 \times 20 \mu\text{s}$ (see 6.5.2).
- c. Pulse repetition rate - A single pulse only shall be applied.
- d. Polarity of pulse - Not specified.
- e. Procedure:
 - 1. Verify the test set-up and that the peak current is within tolerance.
 - 2. Test the inspection lot to verify their capability to withstand the peak current value.
 - 3. When peak current is applied, clamping voltage shall be measured as specified in 4.6.3 and herein.
 - a. The measuring instrument shall employ voltage probes separate from the current conducting connections.
 - b. The probes shall contact the resistor leads no greater than 0.3 inch (7.6 mm) from the resistor body.
- f. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.6.2 and 4.6.3 respectively.
- g. Examination after test - Resistors shall be examined for evidence of mechanical damage.

4.6.6 Pulse life (see 3.11). Resistors shall be tested in accordance with method 4141 of MIL-STD-750. The following details and exceptions shall apply:

- a. Pulse generator source impedance and pulse voltage - Shall be such as to supply the specified current value $\pm 10\%$ (see 3.1).
- b. Pulse width - $8 \times 20 \mu\text{s}$ (see 6.5.2).
- c. Pulse repetition rate - Maximum pulse repetition rate shall be such that the theoretical pulse energy absorbed by the device is dissipated at 90% of the value of the transient average power dissipation, $W_{tm} \pm 10\%$ (see 3.1) and shall be computed by the following formula:

$$P_{RR} = .9 W_{tm}/V_C I_p \times 2 \times 10^{-5}$$

Where:

V_C is the specified clamping voltage (see 3.1)

I_p is the specified current of pulse life test (see 3.1).

- d. Test duration - A minimum of 10,000 pulses shall be applied.
- e. Pulse polarity - Shall alternate as a minimum after every 50 pulses.
- f. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.6.2 and 4.6.3 respectively.
- g. Examination after test - Resistors shall be examined for evidence of mechanical damage.

4.6.7 Energy (see 3.12). Resistors shall be tested in accordance with method 4141 of MIL-STD-750. The following details and exceptions shall apply:

- a. Pulse generator source impedance and pulse voltage - Shall be such as to supply the specified peak current value $\pm 10\%$ (see 3.1).
- b. Pulse width - $10 \times 1,000 \mu s$ (see 6.5.2).
- c. Pulse repetition rate - A single pulse only shall be applied.
- d. Pulse polarity - Not specified.
- e. Procedure:
 - 1) Verify that the peak current is within tolerance and that the pulse energy level is as specified (see 3.1).
 - 2) Pulse energy (E) can be estimated by the following:

$$E = 1.4 V_C I_p \gamma$$

Where: V_C = Clamping voltage

I_p = Peak current

γ = Impulse duration see figure 1

- f. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.6.2 and 4.6.3 respectively.
- g. Examination after test - Resistors shall be examined for evidence of mechanical damage.

4.6.8 Dielectric withstanding voltage (see 3.13). Resistors shall be tested in accordance with method 301 of MIL-STD-202. The following details and exceptions shall apply:

- a. Test voltage - 2,500 V dc.
- b. Duration - 60, -0, +5 seconds.
- c. Point of application - The resistor body shall be immersed to the leads into a container of conductive shot. The shot diameter shall not exceed .032 inch (0.8 mm). One test terminal shall be applied to the conductive shot. The other test terminal shall be applied to the resistor leads which shall be connected together by a jumper wire.

d. Current - 1 mA \pm 20%.

e. Examination after test - Resistors shall be examined for evidence of flash-over, mechanical damage, arcing, and insulation breakdown.

4.6.9 Solderability (see 3.14). Resistors shall be tested in accordance with method 208 of MIL-STD-202. The following details and exceptions shall apply:

a. Number of terminations to be tested - Both leads of each resistor shall be tested.

4.6.10 Resistance to soldering heat (see 3.15). Resistors shall be tested in accordance with method 210 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition - C.

b. Cooling time prior to final measurements - one hour.

c. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.6.2 and 4.6.3 respectively.

d. Examination after test - Resistors shall be examined for evidence of mechanical damage.

e. Method of internal examination - Not applicable.

4.6.11 Resistance to solvents (see 3.16). Resistors shall be tested in accordance with method 215 of MIL-STD-202. The following detail and exception shall apply:

a. Examination after test - Resistors shall be examined for evidence of mechanical damage and legibility of marking.

4.6.12 Flammability (see 3.17). Resistors shall be tested in accordance with method 111 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting - Resistors shall be mounted with the leads horizontal and the body vertical.

b. Point of impingement - The resistor body shall be centered, 1.5 inch, -0.0, +0.25 inch (38 mm, -0, 6.35 mm) above the nozzle rim.

c. Duration of flame application - The flame shall be applied until flaming combustion of the resistor is visible or, for a maximum of 15 seconds in any case.

d. Dry absorbent surgical cotton shall be placed 12 inches (305 mm) below the resistor.

e. Examinations during and after test - The time for flaming combustion of resistors to self-extinguish and the time of persistence of glowing combustion of resistors shall be recorded. The dry absorbent surgical cotton shall be observed for ignition.

4.6.13 Terminal strength (see 3.18). Resistors shall be tested in accordance with method 211 of MIL-STD-202. The following details and exceptions shall apply:

a. Test conditions - A and C (pull test and bend test, respectively).

b. Applied force - Test condition A; 5 pounds. Test condition C; 1 pound.

c. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.6.14 High temperature life (stabilization bake) (see 3.19). Resistors shall be tested in accordance with method 1032 of MIL-STD-750. The following details and exception shall apply:

- a. Test temperature - Maximum rated temperature (see 3.1).
- b. Duration - 24 hours \pm 1 hour.
- c. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.6.15 Thermal shock (see 3.20). Resistors shall be tested in accordance with method 107 of MIL-STD-202. The following details and exceptions shall apply:

- a. Test condition - A, except that step 3 shall be the applicable maximum rated temperature (see 3.1).
- b. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.6.16 Power burn-in (see 3.21). Resistors shall be tested in accordance with method 1038 of MIL-STD-750. The following details shall apply:

- a. Test condition - B.
- b. Test temperature - 85°C.
- c. Voltage applied - Maximum rated ac voltage (see 3.1).
- d. Duration - 72 hours +4 hours, -0 hours.
- e. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.6.17 Moisture resistance (see 3.22). Resistors shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

- a. Load and polarization voltages - Not applied.
- b. Measurements after test - Nominal voltage and dielectric withstanding voltage shall be measured as specified in 4.6.2 and 4.6.8 respectively.
- c. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.6.18 Vibration (see 3.23). Resistors shall be tested in accordance with method 204 of MIL-STD-202. The following details and exceptions shall apply:

- a. Mounting - Resistors shall be rigidly fastened to the test platform and the leads secured.
- b. Voltage applied - Resistors shall not be energized.
- c. Test condition - D (20 G; 10 - 2,000 Hz).
- d. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.6.2 and 4.6.3 respectively.
- e. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.6.19 Shock (see 3.24). Resistors shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions shall apply:

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- a. Mounting - Resistors shall be rigidly fastened to the test platform and the leads secured.
- b. Voltage applied - Resistors shall not be energized.
- c. Test condition - E, except 1 ms duration.
- d. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.6.2 and 4.6.3 respectively.
- e. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.6.20 Constant acceleration (see 3.25). Resistors shall be tested in accordance with method 212 of MIL-STD-202. The following details and exceptions shall apply:

- a. Mounting - Resistors shall be rigidly fastened to the test platform and the leads secured.
- b. Voltage applied - Resistors shall not be energized.
- c. Test condition - B; 20,000 g in the y2 orientation.
- d. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.6.2 and 4.6.3 respectively.
- e. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.6.21 Low temperature storage (see 3.26).

4.6.21.1 Mounting. Resistors shall be mounted in a manner such that there is at least one inch of free air space around each resistor, and in such a position with respect to the air stream that the mounting offers substantially no obstruction to the flow of air across and around the resistors.

4.6.21.2 Procedure. Resistors shall be placed in a cold chamber which is at $-65^{\circ}\text{C} \pm 0^{\circ}$, -3°C for a period of 24 ± 4 hours. The resistors shall then be removed from the chamber and maintained at a temperature of $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for a period of 6 ± 2 hours. The nominal voltage and clamping voltage shall then be measured as specified in 4.6.2 and 4.6.3 respectively. The resistors shall be visually examined for evidence of mechanical damage.

4.6.22 High temperature storage (see 3.27).

4.6.22.1 Mounting. Resistors shall be mounted as specified in 4.6.21.1.

4.6.22.2 Procedure. Resistors shall be placed in a chamber which is at $125^{\circ}\text{C} \pm 3^{\circ}$, -0°C for a period of 340 ± 8 hours. The resistors shall then be removed from the chamber and maintained at a temperature of $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for a period of 6 ± 2 hours. The nominal voltage and clamping voltage shall then be measured as specified in 4.6.2 and 4.6.3 respectively. The resistors shall then be visually examined for evidence of mechanical damage.

4.6.23 Operating life (see 3.28). Resistors shall be tested in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:

- a. If forced-air circulation is employed, there shall be no direct impingement of the forced-air supply upon the parts.
- b. Resistors shall be mounted by their normal mounting means and shall be so spaced to minimize the temperature of one specimen affecting the temperature of another.
- c. Temperature - $85^{\circ}\text{C} \pm 2^{\circ}\text{C}$.

- d. Operating conditions - The rated ac input voltage and frequency shall be applied (see 3.1).
- e. Test condition - D.
- f. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.6.2 and 4.6.3 respectively.
- g. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The resistors covered by this specification are primarily intended for use in electronic equipment to suppress transients which may damage voltage sensitive circuit components. These resistors are unique due to the fact that they must be able to operate satisfactorily in military systems that have passed tests as described in MIL-STD-202. Commercial components are not designed to withstand these military environmental conditions.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Title, number and date of the applicable specification sheet and the complete military part number (see 3.1 and 1.2.1).
- c. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, prior to the award of a contract, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractor is called to this requirement, and contractors are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is Defense Supply Center, Columbus (DSCC-VQ), 3990 E. Broad St., Columbus, OH 43216-5000.

6.4 PIN. PIN is a new term encompassing terms previously used in specifications such as part number, type designation, identification number etc. (see 1.2.1).

6.5 Application notes.

6.5.1 Caution note. Should the varistor be subjected to surge currents and energy levels in excess of maximum ratings, it may physically fail by package rupture or expulsion of material. It is recommended that protective fusing be used. If not fused, the resistor should be located away from other components or be physically shielded from them.

6.5.2 Current test waveform. All tests requiring an impulse of current uses the waveform of figure 1. The waveform is specified by its peak current value and by its time dimensions; for example, $8 \times 20 \mu\text{S}$, where 8 is the virtual front duration and 20 is the impulse duration in μS . The applied test waves are accurate to a tolerance of $\pm 10\%$ for virtual front duration, and to a tolerance of $\pm 20\%$ for impulse duration.

6.5.3 Subject term (key word) listing.

Solder dip/retraining
Varistor
Production lot
Power rating
Part Identifying Number (PIN)

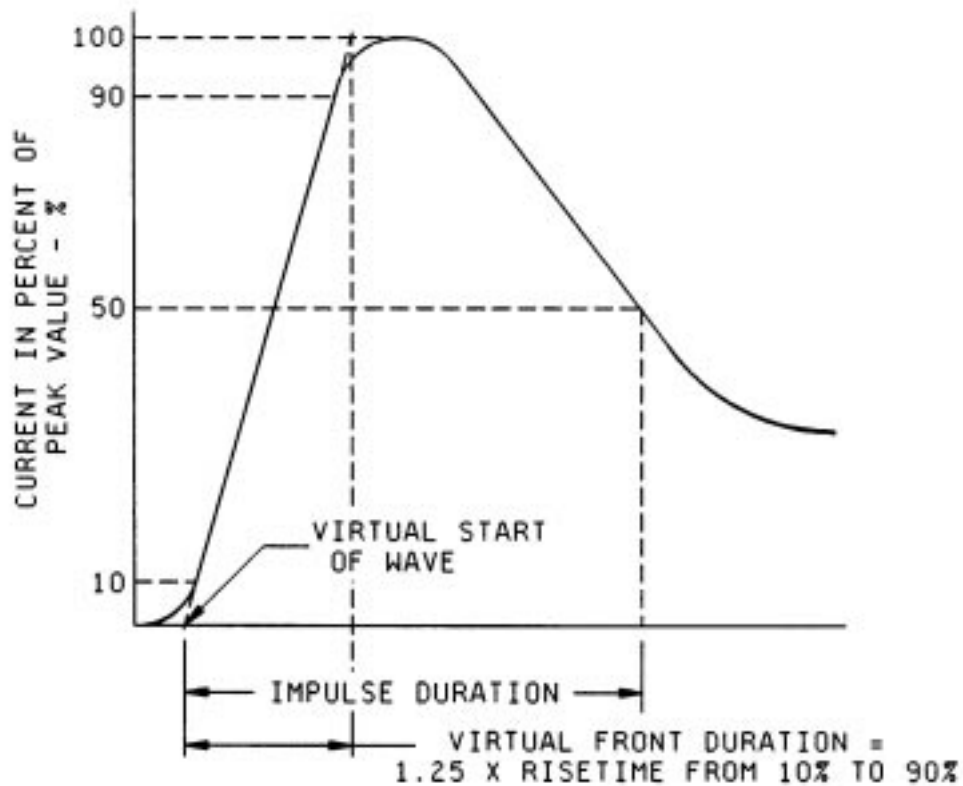


FIGURE 1. Pulse current waveform.

APPENDIX

PROCEDURE FOR QUALIFICATION INSPECTION

10. SCOPE

10.1 Scope. This appendix details the procedure for submission of samples, with related data, for qualification inspection of resistors covered by this specification. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS.

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-1276 - Leads for Electronic Components.

30. SUBMISSION

30.1 Sample. A sample consisting of 52 sample units of each part number for which qualification is sought shall be submitted and subjected to the inspections of table II.

30.2 Test results. Each submission shall be accompanied by test results covering the nondestructive tests listed in table II which have been performed on the submitted sample units. The performance of the destructive tests by the supplier on a duplicate set of sample units is encouraged, although not required. All test results shall be submitted in duplicate.

30.3 Description of items. The manufacturer shall submit a detailed description of the resistors being submitted for inspection, including materials used for the resistor element and the protective enclosure or coating.

40. SOLDER DIP (RETIMMING) LEADS

40.1 Solder dip (retinning) leads. The manufacturer may solder dip/retin the leads of product supplied to this specification provided the solder dip process has been approved by the qualifying activity.

40.1.1 Qualifying activity approval. Approval of the solder dip process will be based on one of the following options:

- a. When the original lead finish qualified was hot solder dip lead finish 52 of MIL-STD-1276 (NOTE: The 200 microinch maximum thickness is not applicable). The manufacturer shall use the same solder dip process for retinning as is used in the original manufacture of the product.
- b. When the lead originally qualified was not hot solder dip finish 52 of MIL-STD-1276 as prescribed in (a), approval for the process to be used for solder dip shall be based on the following test procedure:
 1. 30 samples of any resistance value for each style and lead finish are subjected to the manufacturer's solder dip process. Following the solder dip process, the resistors are subjected to the nominal voltage test (and other group A electricals). No defects are allowed.
 2. 10 of the 30 samples are then subjected to the solderability test. No defects are allowed.
 3. The remaining 20 samples are subjected to the resistance to soldering heat test followed by the moisture resistance test. No defects are allowed.

40.1.2 Solder dip reflowing options. The manufacturer may solder dip/reflow as follows:

- a. After group A tests. Following the solder dip/reflowing process, the electrical measurements required in group A, subgroup 1, tests shall be repeated on the lot. The group A, subgroup 1, lot rejection criteria shall be used. Following these tests, the manufacturer shall submit the lot to the group A solderability test as specified in 4.6.9.
- b. As a corrective action if the lot fails the group A solderability test.

Custodians:

Army - CR
Navy - EC
Air Force - 11
DLA - CC

Preparing activity:

DLA - CC

(Project 5905-1570)

Review activities:

Army - AR, AT, AV, CR4, MI
Navy - AS, CG, MC, OS
Air Force - 19